JLab Web Based Tracking System for Integrated Incident, Accident, Inspection, and Assessments*

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Abstract

The Thomas Jefferson National Accelerator Facility, or JLab, is a Department of Energy particle accelerator used to conduct fundamental physics research. In such a facility there are numerous statutory, regulatory, contractual, and best practice requirements for managing and analyzing environmental health and safety (EH&S) related data.

A tracking system has been developed at JLab that meets the needs of all levels of the organization, from the front line worker to the most senior management. This paper describes the system implementation and performance to date.

Introduction

The ability to accurately track EH&S related findings from first encounter to closure is an important tool in the EH&S professional's arsenal. The DOE requires national lab management contractors to implement numerous programs related to EH&S tracking and reporting. Reports include annual self-assessments, accident and incident reports, operational readiness assessments, EH&S inspection program results, and trending [6]. The lab management requires trend analysis and corrective action tracking to closure on all findings. The EH&S professional requires historical data related to incidents and inspections within a given area or related to a specific individual.

Items are tracked in order to identify trends and provide lessons learned. The intent is to prevent future occurrences of events with similar root causes. Any of the above may also produce information that can be used to develop just in time or topic specific training.

Each kind of report has seemingly disparate requirements depending on the intended audience. In fact, there are report tracking software packages available (at great expense), but these are customized for specific industries or tasks. The authors are not aware of integrated packages that provide the ability to enter and track all of the information needed for a comprehensive EH&S trending analysis.

There were a great many similarities in the basic information required to accurately analyze trends in related functions. For example, work areas or zones within the facility or the management chain for an area or employee will require similar input data, e.g. system owners, personnel supervisors, and location.

Investigation of seemingly unrelated, recent near miss events at JLab uncovered an interesting pattern. Although a strong environmental health and safety (EH&S) program was in place, in practice the program had gaps in two key areas: 1.) Clear lines of communication of EH&S related information were not in place to relay lessons learned, and 2.) Clear lines of management responsibility for hazardous tasks and the personnel that performed them were missing or

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ambiguous. A classic example of the latter is an employee of one department matrixed to another department to perform some type of work. In this scenario, there is a potential for neither the direct supervisor nor task supervisor to take responsibility for performing the task hazard analysis, since each may assume that the other has already completed it.

An initiative was developed in response to these inefficiencies. This initiative would accomplish the following:

- Increase worker awareness of EH&S related action items
- Increase management awareness and ownership of EH&S corrective actions
- Facilitate better communication of EH&S related issues and lessons learned at all levels
- Identify areas where additional focused training may be required

In investigating how these goals may be accomplished, it was recognized that one must be able to view and track a comprehensive set of EH&S related information and have the information integrated and available for interactive research [8]. It is from this initiative the tracking system was developed.

Development

The JLab EH&S tracking system was originally developed as a tool to aid the EH&S Tracking, Trending, & Training (T3) office in the capture and reporting of periodic EH&S inspections. These inspections, along with their associated findings and corrective actions, had originally been entered in a paper logbook that was inaccessible to personnel affected by the finding. The initiative for ensuring a corrective action was closed fell on the line manager for the area. However, the line manager, and indeed the management chain, did not have ready access to the inspection findings. By the time data made its way to senior management in weekly or monthly reports, the information was highly edited. In addition, the inspection reports did not include data that was relevant to similar but a broader class of findings since they were single event driven.

At the same time that the initial inspection tracking system was in the requirements development phase, it was observed that there was a similar strong need for tracking accident and incident investigations and corrective actions. Accident and incidents share many of the same attributes as inspections, but they also have a uniquely significant data subset.

Requirements for the tracking system grew to cover four main functional areas:

- Inspection (includes laser audits)
- Accident/Incident Investigation
- Assessments
- Radiation Deviation Reporting

From these functional areas, a set of requirements was developed that strived to make use of the system as ubiquitous and utilitarian as possible. The requirements are outlined in the following objectives:

- Work across multiple platforms
- Be useable by personnel with limited computer skills
- Viewable by anyone
- Output to other data management tools
- Import data from existing personnel and area databases
- Support trending analysis
- Be secure against unauthorized use

- Support group or individual e-mail notification of affected personnel
- Support electronic logging (e-log) of entries

In addition to the basic functionality, emphasis was placed on the customer requirements. The paper system had been neglected due to lack of accessibility and the T3 system would be no different if it was difficult to access or navigate. Given the cross facility needs for EH&S information, the list of system customers covered a wide spectrum.

Customers:

- Safety wardens
- Professional EH&S Staff
- Line management
- Line management
- Division/department management
- Senior Executive management
- Oversight/Compliance Agencies

Input was solicited from potential users at all levels. In addition, information was gleaned from paper forms in order to present the field worker with familiar form entries. A less obvious requirement was development of the T3 system as inexpensive as possible.

Figure 1 -Tracking System Home Page

System Overview

In order to meet some of the requirements described earlier, it was determined that the system should be implemented in a web-based, client-server environment over the JLab intranet. An overview of the functionality of the T3 tracking system starts with the home page, shown in (figure 1). In addition to normal menu selection items, a set of links related to tracking items is presented to the user. For quick reference there is also a bar graph of open items (draws the curiosity of the user to find out if they are in the hot seat).

Each page of the T3 system is 'built' by the server at the time the page is requested by the client web browser. Embedded within the HTML code that generates each page are calls to a server-side scripting language known as PHP. The PHP scripts fill in variable data such as pull down menus with the most current data in the system database. This is a powerful tool that allows customization of the information contained in the web interface.

This interface resides on an Apache web server within the lab's intranet. Apache HTTP server and the PHP scripting language are open source server applications from the Apache[1] Software Foundation.

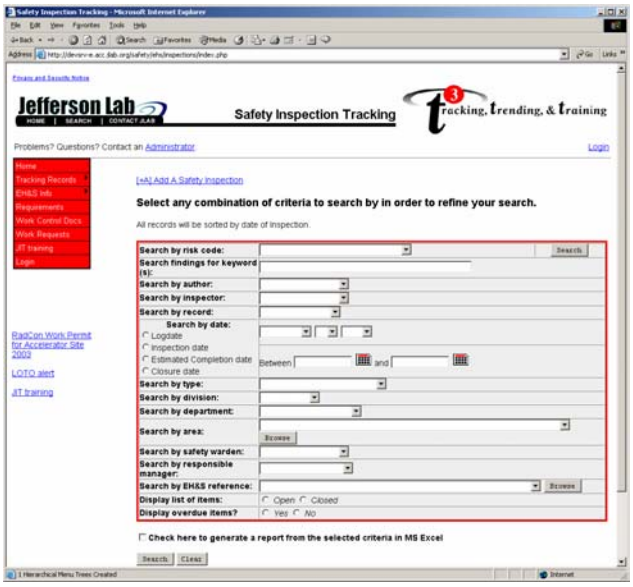

Figure 2 - Safety Inspection Interactive Web

When the web server receives a request for a PHP page, it tells the PHP engine to build it. PHP reads the code in the page and builds a context based HTML page depending on a number of factors; including the type of login, input variables, and if required, executed database queries. This HTML is then given back to the server in order to deliver it to the client's browser.

There are presently four links within the Tracking Items link box. Each one will bring up a context dependent database query dialogue box tailored to the task. For example, an inspection dialogue form (figure 2) may include information on safety wardens that are linked to a specific area. This would not be an appropriate entry for an assessment database query because assessments are not related to individual areas of the lab. Common items, such as the responsible manager, are available among various dialogues. Reports are available as a printable web page or may be opened in an Excel® spreadsheet for further analysis.

Inspection items include formal, informal, and incidental findings [1, 7]. Each finding includes a risk matrix assessment of the potential harm that could be caused if the item were left unmitigated. Formal findings are generated during the monthly to quarterly scheduled inspections performed by professional EH&S staff. Informal findings are identified by safety

[1] Apache Software Foundation http://www.apache.org/

wardens.[2] Incidental findings are observations made by EH&S professionals and line managers in the course of performing other work activities.

Accident/Incident items include tracking corrective actions and the lessons learned from these events [2-4]. Prior to implementing the tracking system, it was noted that the closure process tended to break down once the accident report was transmitted to DOE. Since implementing the tracking system, accident rates have improved through timely and effective closure of corrective actions and potential areas for improvement to the accident investigation process have been noted. Moreover, by correlating the root cause data to DOE's Integrated Safety Management System (ISMS) principles and core values within each finding record, gaps in JLab's ISMS program implementation have also been identified and targeted for corrective action. A nice feature that was added to the system is a hyperlink associated with each record that connects the user to an electronic copy of the relevant accident/incident report.

Assessments include findings from two sources: periodic line self-assessments of EH&S performance and independent assessments [9, 10]. Line self-assessments are subjective performance evaluations prepared by department heads. They provide the departments the unique opportunity to identify their accomplishments while at the same time identifying areas for improvement in both operations and EH&S performance. Independent assessments are objective evaluations of a department's EH&S performance. The Office of Assessment that reports to the Lab Director performs them.

Radiation deviation reports (RDR) include data and corrective actions related to deviation from radiation control processes [5]. These deviations fall below the threshold for external reporting.

However, if they are not effectively resolved and repeat findings occur, the RDR could be elevated to an external oversight agency for follow up.

One important requirement of the system is to ensure that ownership of an open item, from introduction to closure, belongs to a single individual. To ensure this, a responsible manager is assigned to each finding to guarantee that there is one point of contact for the closure of every item.

Integration with E-log and E-mail

The JLab scientific operations make substantial use of electronic log books for documentation of machine operations. Several sub logs also exist, which are tied to specific operational areas or pieces of equipment (figure 3). To facilitate communication of EH&S related information, an EH&S sub-log was created. Users may enter log activity independently into the tracking system or they can automatically generate an associative e-log entry when a T3 item is created or updated [8].

[2] Safety wardens are appointed by their supervisors and are drawn from the pool of employees routinely working at a specific work area location. They serve as an extension of the professional EH&S staff in the day-to-day EH&S oversight of their work area and the people accessing it. They can take the initiative to fix the problem, log the problem and see the solution through to closure.

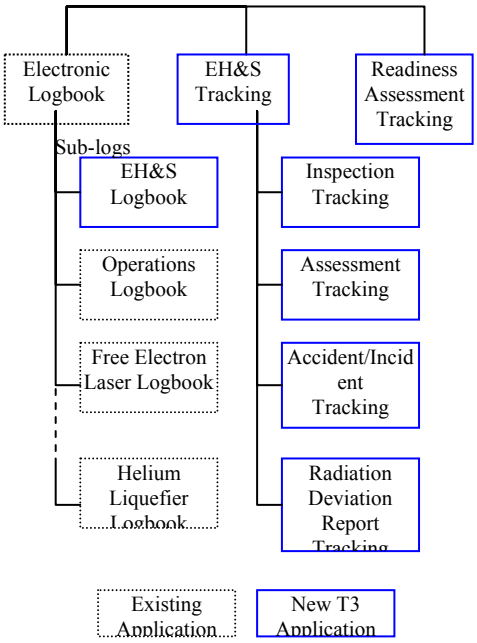

Figure 3 - Hierarchical Diagram of T3

Both the T3 forms and the e-log systems have the ability to e-mail interested parties. E-mail messages are generated automatically, but the user selects the respondents to which they wish to notify about a particular item.

Readiness Assessment

An offshoot of the T3 system was a safety readiness review tracking system. All DOE accelerators are required to perform a safety assessment and identify and track hazards and associated mitigations for any new facility or operation. In the development of such a document, hundreds to thousands of safety related items might be identified and tracked to closure. To ensure that open items are addressed in a timely manner, the tracking system must also track progress towards resolution of safety issues and concerns.

The T3 ReAD (Readiness Assessment Documentation) tracking system does just this using a matrix layout and color coding [11]. The matrix items are interactive with changes and updates added by a mouse click on any underlined item in the matrix. Changes and updates are posted in real time so that the matrix always represents the most current information.

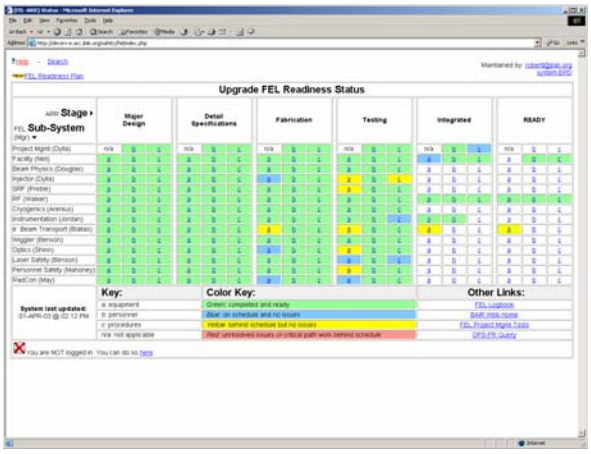

Figure 4 -FEL Readiness Assessment Matrix

Design

A functional diagram of the T3 tracking system is shown in (figure 5). Anyone connecting from within the lab Enterprise intranet may access the Apache web server that delivers the PHP pages for the system. These connections are allowed to pass through onto the Controls intranet because the firewall separating the two networks is configured to allow this. However, the Oracle database server only allows connections from within the Controls intranet, so users must first connect to the Apache web server in order to access the database for the system.

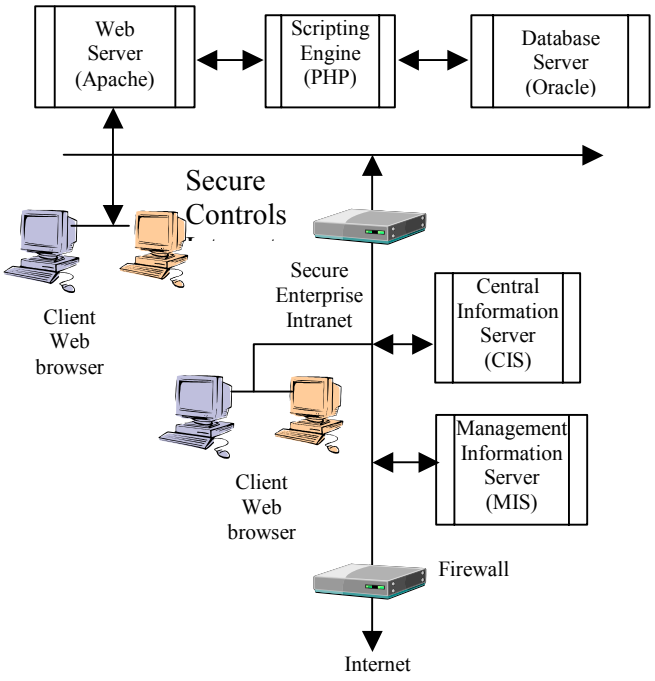

Figure 5 - System Connectivity Diagram

Data Entry and Security

Data can be viewed by anyone within the organization firewall, allowing the system to remain independent from outside the lab, but creation of new entries requires that the user be authorized to use the system. To ensure this authorization, the database keeps a table of authorized users. In order to make a new entry or modify an existing entry, the user must login to the system. Logins are authenticated by a separate and secure section of the web server so that user passwords cannot be sniffed. The header of each page contains a link for the user to log in to the secure server. The user provides his or her username and password over a secure connection to complete this process. If the username and password is not valid, an error message is returned. Once logged in, the user may update or create records for which they are authorized. Administrators are the only people who may delete entries.

Each browser form runs a simple JavaScript function on the client which checks for input completeness before sending the form variables to the server. These variables are used to input the data into the database. This client-side check is done in order to avoid having to tie up the server with these tasks.

For example, when the client opens the inspection form, the PHP engine builds the HTML for the pull down menus dynamically. This information is based on current information contained in the central information server, the management information server, and the Oracle database for the application. These databases contain relational information such as employee/department/division/supervisor/e-mail/inspection type/address and so on. The user then selects the appropriate options from these menus and inputs data into other text boxes. When the user submits this information to the server, the JavaScript checks to see if the required fields are filled out. If they are, the form variables are sent back to the server and their values are added to the database.

Conclusions

A web based tracking system has been developed at Jefferson Lab that meets the needs of a diverse set of customers – from casual to EH&S professional. The system has been in beta test for 6 months and in use for another 6 months. The reception to date has been very enthusiastic and the system is in wide use through out the facility.

References

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Biography

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Ms. Prior is the Jefferson Lab (JLab) Accelerator Division EH&S principle responsible for tracking, trending, and training. She is also the JLab EH&S Policies and Manual Group Manager. Over her career, Sandra has developed numerous database applications for environmental health and safety related applications. She is the principle designer and author for the database applications described in this paper.

Sandra is a member of the adjunct faculty at Old Dominion University in the Environmental Health Department School of Health Sciences. She is on the Adjunct faculty at the U.S. Army Command & General Staff College (CGSC) in Ft. Leavenworth, KS. She is a member of the Environmental Health Advisory Council for environmental health programs at ODU. She is a member of the United Who's Who Registry of Executives and Professionals. She is also a Registered Environmental Manager and a Certified Hazardous Materials Manager, Masters Level.

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